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SEWAGE DISPOSAL SYSTEMS APPLICABLE TO SUBDIVISIONS

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Cincinnati, Ohio

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SANITARY ENGINEERING CENTER
CINCINNATI, OHIO

by

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Robert A. Taft Sanitary Engineering Center
Cincinnati, Ohio

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"SEWAGE DISPOSAL SYSTEMS APPLICABLE TO SUBDIVISIONS"

By James B. Coulter
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I am certain that the Home-Builders of America are well aware of the confusion that exists in dealing with "Subdivision Sanitation." In spite of its significance to home builders, home owners, and public health officials alike, this topic has received far less attention than it deserves. True, the collection, treatment, and disposal of sewage in suburban areas has been the subject of much talk, numerous investigations, and many newspaper campaigns; but the fact remains that to date applied research leading to workable solutions of the problem has been insignificant in face of the many complex obstacles which must be surmounted.

In spite of this dreary picture some important studies have been made and others are now in progress. I am sure that you would have me spend the time allotted on this panel discussing the things that have been accomplished and the work now under way; rather than elaborating on our lack of knowledge.

INDIVIDUAL HOUSEHOLD SYSTEMS

Where extension of an existing sewerage system is impractical, sewage disposal for subdividions logically comes under two categories; the household system serving an individual house, and the community system serving a group of houses. Although it may appear that the difference is merely one of the number

of houses served, there is a very important technical difference that must never be overlooked. The individual system should accomplish complete disposal of the sewage liquid. On the other hand, the community system should provide treatment so that the sewage liquid can be safely discharged to the surface of the ground. There are exceptions to this rule, but in general it holds.

Soil Absorption

The septic tank followed by absorption of the liquid in the ground is the most widely used scheme for individual disposal. Under the proper circumstances this system has demonstrated its ability to give good performance. On the other hand, under improper circumstances the same system has demonstrated its ability to bring trouble, embarrassment, and even financial loss to all concerned.

Fortunately, studies have revealed the conditions under which a septic-tank soil absorption system will perform satisfactorily. In general there are three conditions:

1. The soil and subsurface formations must be suitable.
2. The system must be designed properly and constructed with care.
3. The system must receive proper use.

Of these three factors, the soil is the most important and the one over which the house-builder has no control. Unfortunately, over half of the soil in our country is unsuitable for absorption

of a large volume of liquid. Furthermore, the unsuitable soil is apt to be found on the high ground desirable for house building, while suitable soil is likely to be found in the bottom-land that is highly desirable for agriculture.

To my knowledge there is no practical means of opening up impervious soil. For that reason the builder should thoroughly investigate a piece of land, and if possible he should obtain advance committments from F.H.A., V.A., and the local health department before he buys. The best method for determining the suitability of land is by a competent on-the-site investigation including percolation tests and soil soundings. Soil maps used in conjunction with experience with existing systems in the area are very valuable. When consulted in advance the health department can be the builder's best friend. For instance, in Louisville, Kentucky, it is possible to write an escape clause into the agreement to purchase land. Through an arrangement with the City-County Health Department agreements are made contingent upon the approval of the land for septic tank systems.

Even in good soil, poor design and improper construction will doom a system to early failure. In the past it seems to me that the building industry has been at least suspicious and in many cases overly critical of the septic tank regulations imposed by the health or plumbing department. Industry should be alert to see that regulations keep abreast of the development of knowledge, but it should also actively support those regulations that promote good results.

I believe that builders are becoming more sympathetic with a good permit system requiring prior approval of plans and final inspection before a septic tank system is covered. These controls help to eliminate unethical competition. In addition, the existence of a record of prior approval and final inspection on file at the health department has saved the reputation of many a builder from unwarranted suits by home owners.

Even with good soil and good construction it is possible for the home owner to cause his system to fail. Builders could provide a good service by joining in a campaign to educate home owners on these two simple points. First, through excessive water use or the addition of appliances it is easy to overload the system. Second, the septic tank should be inspected annually and cleaned when necessary before excess sludge can be carried to the disposal field where it will damage the soil.

Other Individual Household Systems

Prompted by the unsuitability of septic tanks for general application and the public demand for a workable individual household system, several manufacturers have made sizeable investments in this field. This is a refreshing and promising development, but one that has proved to be a dilemma for health authorities. An overly conservative attitude may stamp out initiative in the field, but on the other hand, prime responsibility for the health of the community rules against acceptance of an untried device. Strong

action is needed to promote an organization enjoying the respect and confidence of both health official and manufacturer to test such devices.

None of the systems on the market have received widespread approval by health authorities. It seems likely that such approval will be contingent upon the demonstration of: absence of health hazard; absence of nuisance; and dependability of operation.

COMMUNITY SYSTEMS

Except under ideal circumstances the community system has a number of advantages over the individual system. Eventually when the population density in a suburban area increases to the point where it is possible, an existing sewerage system should be extended; or a collection system and control treatment plant large enough to serve the entire drainage basin should be constructed. This task is simplified when a small treatment plant, street sewers, and house sewers are built with each subdivision in conformance with a unified plan. In this way sewage is brought to a central point where it can be picked up by a trunk sewer at a later date. The home owner is spared the double expense of first a septic tank and then street sewers. By including street sewers in the cost of the house, part of the debt limit is preserved for other civic improvements. Better control can be maintained over the design, construction and operation of community plants. In many instances the first cost of a community system is actually less than that of individual septic tanks.

To meet the demand for small sewage treatment plants a number of reliable manufacturers are producing "package" plants. With proper attention these plants give good results when properly selected for a given job. In addition they are compact, require a minimum amount of engineering, and place the responsibility for equipment at one source. This last advantage can be of tremendous importance to the builder during the break-in period when adjustments are required. Unfortunately many "package" plants are scale down models of large municipal plants, with too little attention given to the problems of the small subdivision.

There are a number of features which a candidate for a subdivision sewage treatment plant should possess:

First, it must produce a relatively clear, odorless effluent low in solids and biochemical oxygen demand. As the plant will be located in close proximity to homes it must be free of odors, insects and other nuisances. As a final safety precaution, disinfection of effluent may be a common requirement.

Second, it must be low in cost. There are those who feel this requirement is of minor importance, yet to be practical the total cost of the sewage treatment plant and collection system must be competitive with the total cost of individual systems. In this regard, widespread application of recommendations stemming from recent studies will increase the

cost of septic tank systems. Furthermore, when computing the cost of a community system, credit should be taken for the increased value of the lot and in most cases the increase in the number of building lots per acre. If the subdivision plant is considered expendable in the over-all plan for a drainage basin, it must be inexpensive to avoid criticism and excessive opposition when the plan is put into effect.

Third, it must be easy to maintain. Successful operation of the simplest plant depends on the maintenance it receives. If the maintenance requirement is unreasonable the plant will soon be neglected and thus the total investment is worthless. Reasonableness can be measured in terms of dollars and cents. In any community there is a maximum monthly charge that can be collected for sewer rental. If that is four dollars per home per month, the operating fund for the sewers and the treatment plant serving 100 homes is $400 per month. This assumes capital recovery from sale of the houses, and eventual replacement by a central sewerage system. As the great majority of builders produce less than 25 homes per year, smaller plants or cooperative endeavor will be required to effect quick recovery of the investment. If smaller plants are used, the operating budget gets proportionately smaller,

but unfortunately, the operational difficulties remain the same or may even increase.

Regular maintenance depends on a reliable continuing arrangement to operate the plant. Of equal importance, in the long run, maintenance will also depend on psychology, location, and design. If the plant is conveniently located there is a good chance that the operator can make his daily visit even in bad weather. If the plant is designed so that critical points requiring attention are readily accessible they will probably receive attention. On the other hand, if the plant has a built-in makeshift appearance, if it is located a mile and a quarter down a muddy path in a swamp, and if the operator has to come in contact with sewage to get to the critical points in the plant, there will be little maintenance.

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LAGOONS

Sewage lagoons are a topic of current interest, and have received considerable investigation by the staff at the Robert A. Taft Sanitary Engineering Center. Depending a great deal on the degree of sophistication the author wishes to convey, sewage lagoons are also known as "oxidation ponds" or "waste stabilization ponds." They approach the ideal for producing good effluent at low cost with minimum maintenance, and may in the long run prove to be the salvation of subdivisions. Lagoons require considerable area, recommended loading varying between 25 and 50 homes per acre of lagoon. However, small ones work well and the land is salvageable

so that temporary lagoons fit into a patt rn of stage construction. For instance, in Missouri, a lagoon is constructed on the slope of a basin that is to be developed. Houses are built above it until the area is used. A new lagoon is then constructed further downstream, to serve both the existing homes and the new construction. Eventually the basin is fully developed and sewers have been included in the purchase price of the houses.

Between 300 and 400 approved sewage lagoons are being used under widely varying soil and climatic conditions. Investigations of existing systems indicate that:

1. Inlet should be located near the center of the pond with the outlet at the edge and as far away from the inlet as possible.
2. If full advantage is to be taken of lagoons, they should receive untreated raw sewage.
3. Present loading recommendations are 100 to 200 persons per acre, but higher loading may be permissable under some circumstances.
4. Area of lagoons investigated ranges from 0.7 to 85 acres with an average liquid depth of 4 feet.
5. Treatment provided by lagoons is equivalent to secondary treatment with conventional plants. Initial cost is 1/2 to 1/3 of that for the conventional plant.

6. Maintenance is simple. Trouble and nuisance free operation has been attained with nominal grass cutting and good housekeeping practices.

ANAEROBIC CONTACT PROCESS

Considering the pattern of housing construction, and especially the situation of the small builder, there is need for a low cost compact sewage treatment plant that can be built in close proximity to the homes served without reducing property value. As previously mentioned, first-cost and operating budget will decide whether any endeavor in this direction is practical or is a merely a laboratory conversation piece.

A cursory examination of small treatment plants reveals that most of the problems of design and operation stem from the necessity to supply air. If a stable, nuisance free effluent could be produced without the aid of aeration, the plant would be greatly simplified. A number of investigators at the Robert A. Taft Sanitary Engineering Center thought that this might be possible if results of some almost forgotten studies of 1910 to 1920 were combined with recent developments in anaerobic treatment of industrial waste.

A scheme is being tested in which raw sewage is brought into contact with digesting sludge and solids are subsequently separated in an upflow submerged rock filter. After a year of work in the laboratory under a variety of controlled conditions,

results were so promising that a pilot plant was constructed at Loveland, Ohio. Studies with this plant are progressing to further define the process and develop design criteria.

Although data are far from conclusive at this point, indications are that the desired degree of treatment can be obtained with a design displacement time of 24 hours. The tanks should be underground to provide insulation and minimize temperature difference between raw sewage and tank content. The inlet pipe should extend from the top of the tank down through the liquid and discharge near the bottom below the sludge level. The desirable proportion between tank capacity and rock capacity has not been established. Sulfide production remains the greatest threat to the endeavor.